Space Weather Technical Forecast

Issued on Sunday, 16 January 2022 at 12:38 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of G1/Minor Storm intervals Day 1 (16 Jan). Chance of M-class flares (R1/R2 radio blackouts) throughout. Active fluence likely by Day 4 (19 Jan).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with several C-Class flares over the past 24 hours. There are currently 7 sunspot regions on the visible disc. AR2929 and AR2930 in the northwest quadrant have the most complexity but no significant flare activity. 2932 in the northeast is showing some development with significant areas of flux visible within its large plage region. 2933 in the southeast is also developing is size and spot number. The remaining sunspot groups are relatively small and simple, though
A CME from the northwest of the Sun on the 15th January may give a weak glancing blow at Earth late on the 16th or early on the 17th, otherwise there are no Earth-directed CMEs visible in imagery.

Solar Wind / Geomagnetic Activity: Solar winds as observed by DSCOVR at L1 showed a transition into the main part of the HSS associated with CH44/-. Wind speeds started at slightly elevated levels, before increasing after 15/1400 UTC to reach elevated levels at 550-600 km/s with a peak around 640km/s at 16/0249UTC. It has subsequently settled at near 550km/s. Density was mostly above average, peaking at 20 ppcc between 15/1200-1400 UTC. Total IMF strength, Bt, was at moderate levels at first, peaking at 13 nT around 15/1500 UTC, before easing to back to weak levels below 7nT from 16/0001UTC. The Bz component varied moderately between +11/-12 nT, before declining to +5/-5 after 16/0001UTC. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Unsettled to Active, with a G1 interval 15/2100-2359 UTC, it eased to Quiet from 16/0600UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels throughout. High energy electron flux (greater than 2MeV) was at background levels, before increasing to moderate levels after 16/0600 UTC. Electron fluence remained well below the Active threshold (1e8 integrated pfu) on a steady trend, with 1.81e6 integrated pfu recorded at 16/0001 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low with further C-class flares expected and a chance of M-class flares. Another two regions are expected to rotate on from the far side within the next two days, and this could also increase solar activity.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently expected, although one CME is expected to pass close to Earth on Day 1 or possibly early on Day 2 (16-17 Jan). The solar wind is expected to be elevated through Day 1, starting to decline from Day 2 onwards. Occasionally Unsettled to Active periods are likely on Day 1, with isolated G1/Minor Storm intervals still possible at first, and then to a lesser extent later on Day 1 into Day 2 due to possible weak CME influences. Geomagnetic activity is then expected to decline to Quiet to Unsettled levels during Days 2-4 (17th-19th).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is forecast to remain at predominantly background levels. The high energy electron flux (greater than 2MeV) may start to rise through this period. The associated 24-hour electron fluence is likely to increase, although the timing and extent of this is low confidence. Fluence may reach Active levels by the end of the period.

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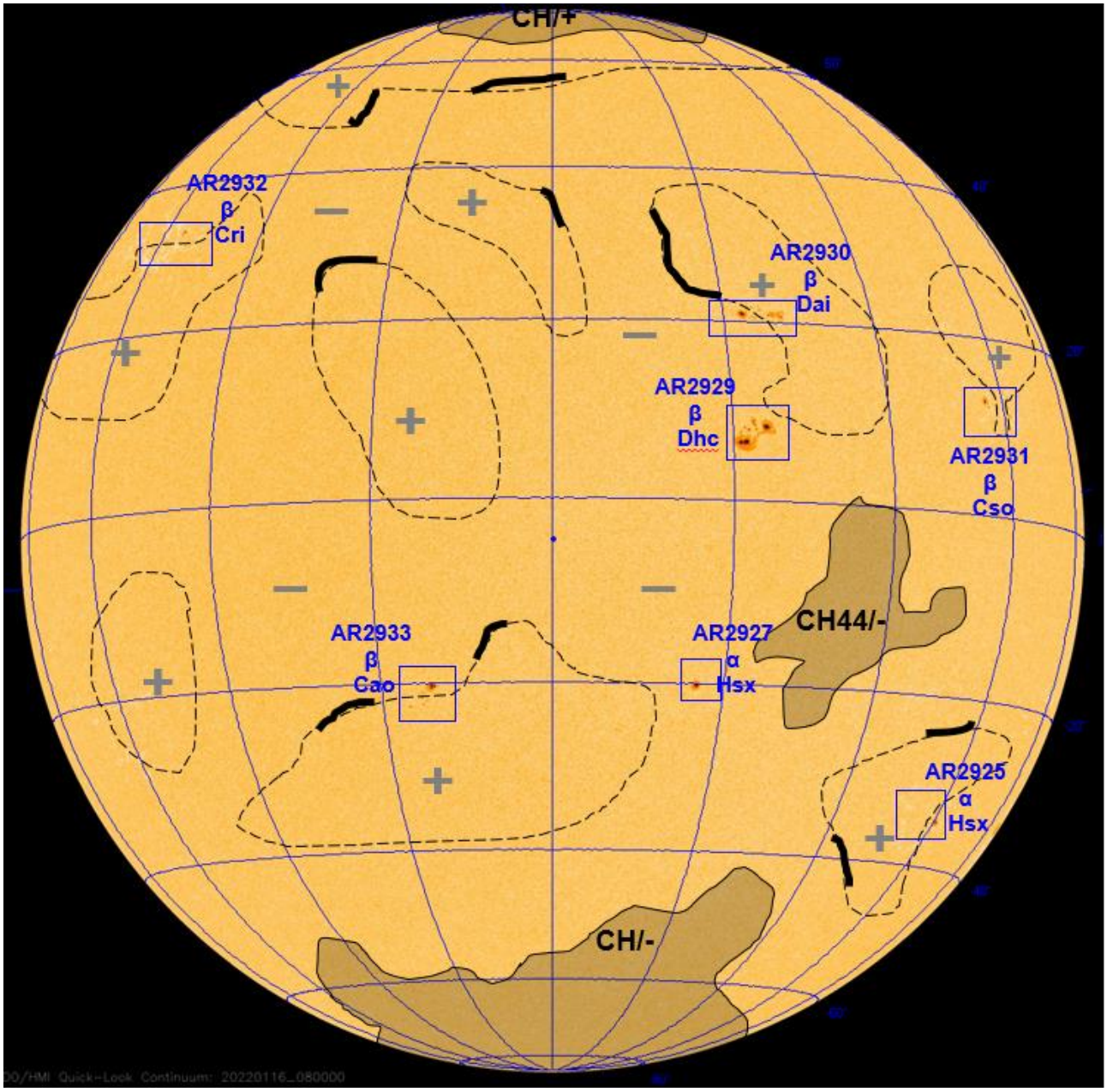
Figure 1. Solar Analysis Valid 16/0800UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME from the northwest of the Sun on the 15th January may give a weak glancing blow at Earth late on Day 1 (16th) or early on Day 2 (17th) also the CME associated with a filament lift-off on the afternoon UTC of the 14th, in the southwest quadrant near AR2925, is expected to pass close to Earth on Day 1 or perhaps early on Day 2 (16-17 Jan). This was a southward directed CME so the bulk of the ejecta is expected to pass below Earth. Confidence is low regarding both CMEs, but there is a slight chance of weak CME influences at Earth, although these are likely to be mixed with the effects of the HSS.

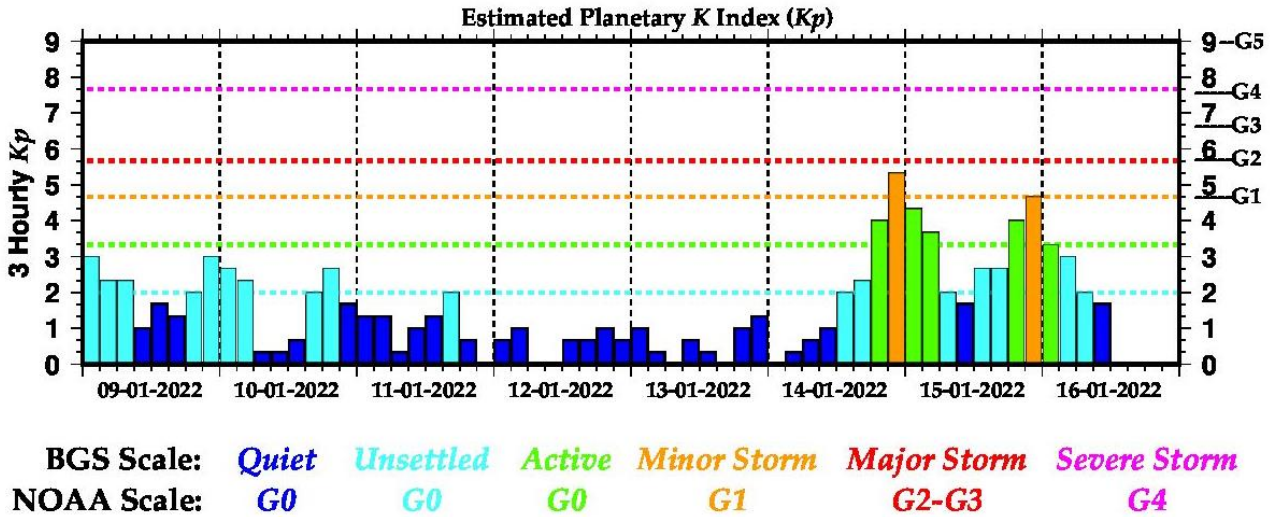
The solar wind speed is expected to continue at elevated levels through Day 1, with speeds around 550 km/s. The HSS influence is then expected to gradually decline back to ambient levels from Day 2 (17th) onwards.

Occasionally Unsettled to Active periods are likely on Day 1, with isolated G1/Minor Storm intervals still possible, and then to a lesser extent later Day 1 into Day 2 due to possible weak CME influences. Geomagnetic activity is then expected to decline to Quiet to Unsettled levels during Day 2.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	20	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections - Nil

Figure 2: BGS Kp index shows the recent enhancements due to the HSS from CH44.



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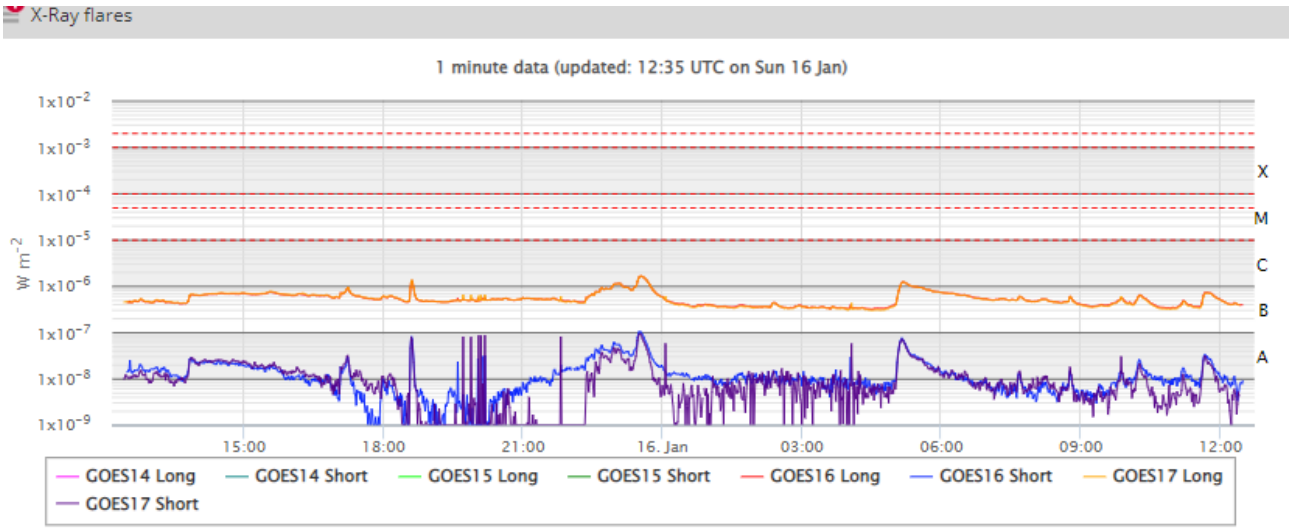
Radio Blackouts - X-Ray Flares:
Solar activity has been Low with several C-Class flares over the past 24 hours. There are now 7 sunspot regions currently on the visible disc. AR2929 and AR2930 are the two regions most likely to produce a significant flare to their size and complexity. 2932 in the northwest is showing some signs of development as is 2933 in the southeast. The remaining 3 regions are small and stable.
Two further far-side sunspot regions (ex-2916 and 2918) are also likely to rotate onto the disc on Days 1 and 2 (16-17 Jan). This brings a slightly increased chance of M-class flares, and probabilities have been increased during the period to reflect this.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	40	40	40
Very Active	R3 to R5 X Class	No	2	5	5	5

Figure 3: A few low c-class X-Ray flares



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 has returned to background levels. Background levels are forecast to continue barring any significant flares or new Earth directed CMEs in the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	2	2	2	2
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

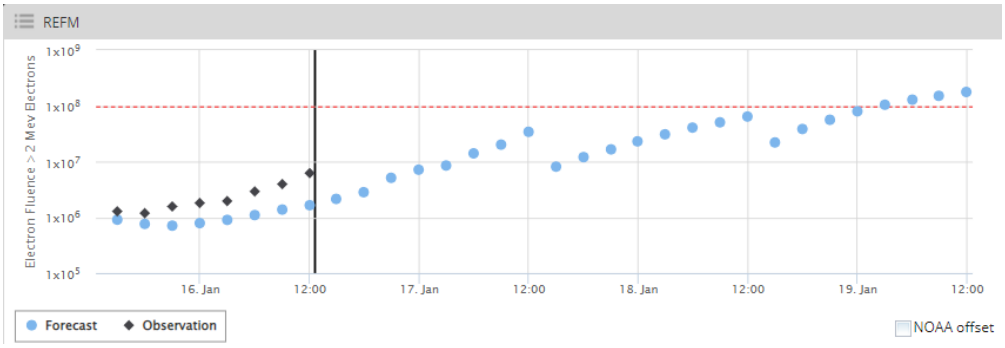
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 has been predominantly at background to moderate levels. Flux levels are likely to rise when the radiation belts de-compress as the HSS of CH44 wanes. This feature on the previous rotation did give an electron response with flux reaching High levels. However, the possibility of a glancing blow from a CME later on Day 1 or perhaps early Day 2 (16-17 Jan), may cause an initial suppression in electron levels which means the forecast is low confidence.

The associated 24-hour electron fluence will start below the Active (1e8 integrated pfu) threshold, with the possibility of an increase during this period, and may reach Active levels by Day 4 (19 Jan). The Met Office REFM output is currently giving reasonable guidance, showing an increasing trend in the fluence levels, reaching Active during Day 4 (19th Jan).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	20	40	50
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: MOSWOC REF Model shows an increasing fluence trend.



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